Space Weather Technical Forecast

Issued on Sunday, 12 December 2021 at 12:44 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Geomagnetic Storming days 3 and 4 (14th-15th)

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity remained Very Low over the past 24 hours, with no significant X-ray flares recorded. There is currently one unnumbered sunspot region on the visible disc, which has recently emerged in the southeast quadrant. The sunspot region is currently small and relatively stable, and is currently classified as a Beta/Cao. This sunspot region will continue to be monitored for any solar flare activity. No Earth-directed Coronal Mass Ejections (CMEs) were evident in available satellite imagery over the period.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was at background speeds, between 300 and 320 km/s throughout. Density was average or just above above average. The Interplanetary Magnetic Field strength (IMF), Bt, was Weak, peaking at around 8 nT throughout, with a variable Bz component ranging -6 nT to +4 nT. Phi angle was negative (towards the Sun) throughout. Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels. The high energy electron flux (greater than 2 MeV) was Background to Moderate. The associated 24-hour integrated fluence fell from 9.02e7 integrated pfu at 11/0001 UTC to 1.16e7 integrated pfu at 12/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to stay Very Low in the period given the absence of Earth-sided sunspots.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Solar winds are forecast to be at background until at least day 3 (14th) into day 4 (15th) when an enhancement is then likely from the High Speed Stream of coronal hole 32 and 34, with elevated solar winds possible. Geomagnetic activity is forecast to be Quiet with a chance of Unsettled during days 1 and 2 (12th and 13th), but increasing to Unsettled to Active with a chance of G1/Minor storms later day 3 into day 4 (14th-15th).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels. The high energy electron flux (greater than 2 MeV) is likely to vary between Moderate and Background levels, with the associated 24 fluence persisting below the Active (1e8 integrated pfu) threshold.

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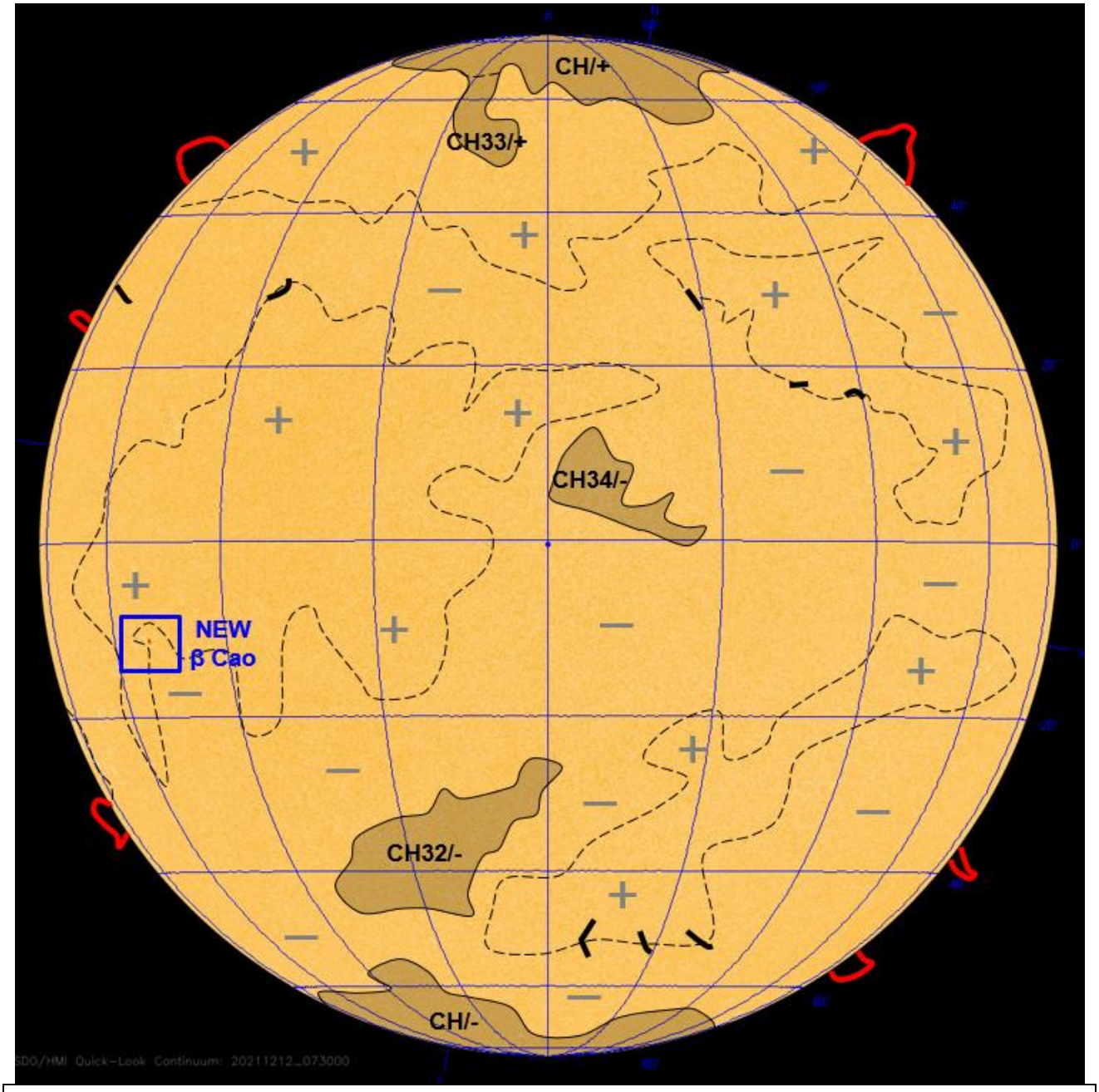
Figure 1. Solar Analysis Valid 12/0730UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:
There are no Earth-directed CMEs. Solar winds are currently at background levels. The main features of the forecast are coronal holes 32 and 34. CH32 brought fast winds of near 600 km/s on the previous solar rotation, but was a larger feature that was notably more westward extended, whereas CH34 (centre disc) was not visible on previous rotation. The eastward retreat and reduced size of CH32 hole suggests a later arrival than persistence would indicate, most likely on day 3 or day 4 (14th-15th). However, with the emergence of CH34, which is further west than CH32, solar winds are likely to be enhanced similar to previous forecast, by day 3 (14th).

Geomagnetic activity is forecast to be Quiet day 1 and day 2 (12th and 13th), with a chance of Unsettled intervals, but increasing to Unsettled to Active with a chance of G1/Minor storms later day 3 into day 4 (14th-15th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	30	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections – Nil.

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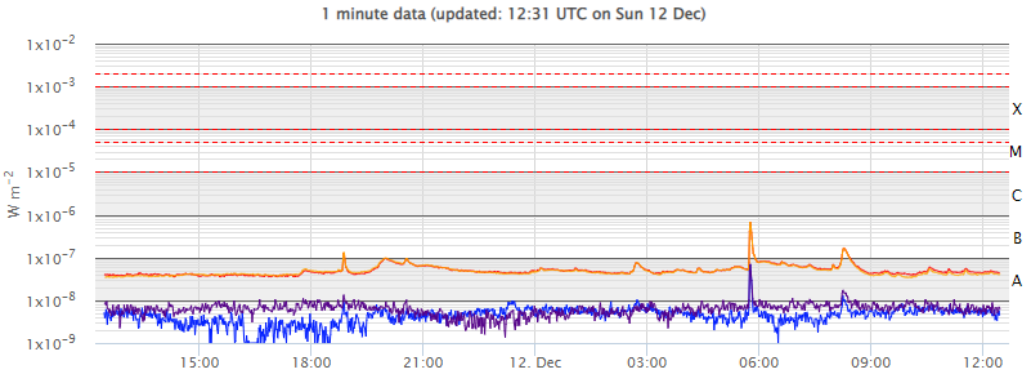
Radio Blackouts - X-Ray Flares:

Solar Activity has been at Very Low levels during the past 24 hours, with only a B6 flare observed at 12/0546UTC from the bright region seen around the southeast limb. There is currently one sunspot region on the visible dsc, which has emerged in the southeast quadrant in the past 6-12 hours. This is yet to be numbered and is currently classified as a Beta/Cao, with its leading spot having a penumbra.This will continue to be monitored for any solar flare activity, but is currently small and relatively stable at present. This region may give a 20% chance of producing C-class flares.

Figure 2: X-ray flares over the past 24 hours.



A bright region of flux is visible on STEREO A EUVI imagery, with some associated magnetic looping visible on SDO imagery. This is likely to rotate onto the Earth-facing side over the next 24-48 hours. Whilst it is uncertain that this region will contain any notable spots, this may bring a chance of increasing flare activity, once it has rotated onto the visible disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

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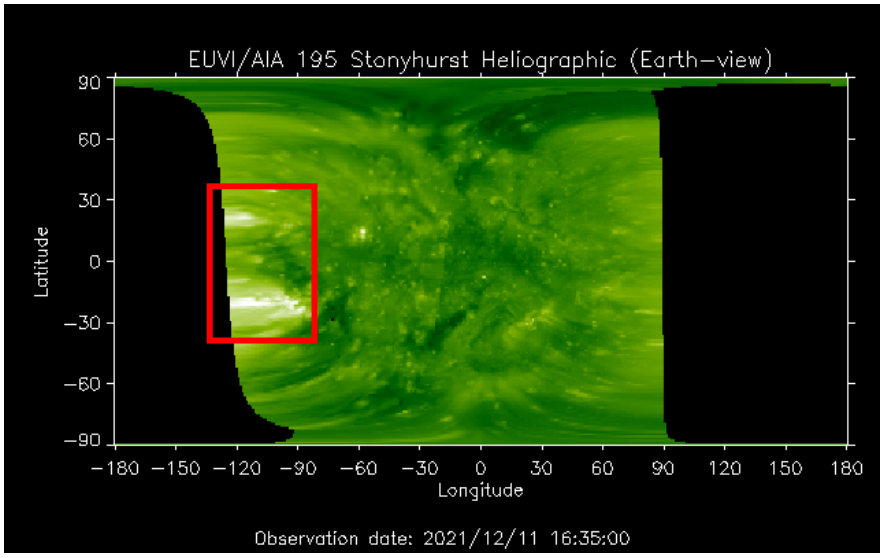
Figure 3: STEREO-A EUVI imagery shows bright flux (red square) regions is visible around the east limb, which is expected to rotate onto disc over the next few days.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is forecast to remain at background levels.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as observed by GOES-16 are expected to generally be Background to Moderate with just a chance of reaching High (greater than 1000 pfu) at the diurnal maximum.

The associated 24 hour fluence is expected to persist below the Active level, but with a very slight chance of rising above. This is supported by REFM which maintains fluence levels below the Active threshold.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	5	5	5

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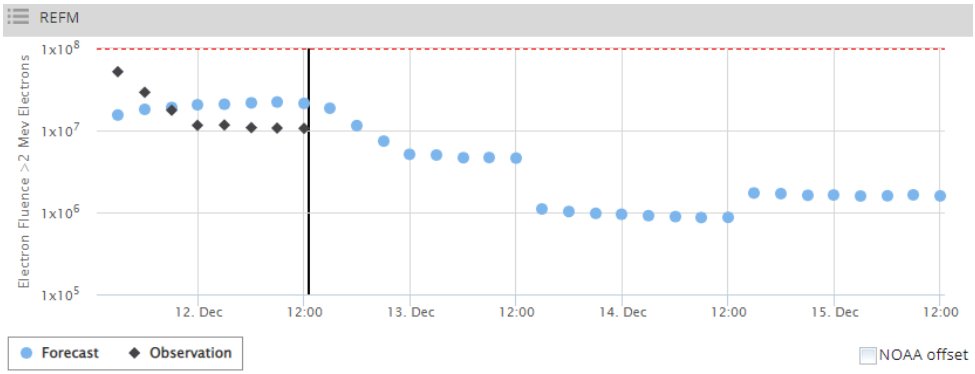
Very Active	**≥ 2 MeV ≥ 1x10⁹**	No	1	1	1	1

Figure 4: MOSWOC REFM is forecasting a downward trend in electron fluence.



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